Pathway to Eco Industrial Development in India

Concepts and Cases

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FOREWORD

Dr. Tishya Chatterjee, MoEF
Dr. Dieter Mutz, GIZ

India is becoming one of the fastest growing economies in the world. With new policies such as the *National Manufacturing Policy,* the *Government of India* envisions to increase the manufacturing sector's contribution to GDP by 25 %. This goal is to be achieved by 2022, together with an increase of competitiveness as well as double the employment in this sector. This clearly shows that the industrial sector in India will assume more importance than ever before.

However, the last few decades have made it evident that economic development does not happen in isolation from environmental protection and social progress.

Technological progress, globalisation of trade and commerce, a growing knowledge base as well as active participation of the civil society need to come together to achieve sustainable development.

Eco Industrial Development is a promising strategy for promoting sustainable industrial development, while tackling environmental, economic and social aspects in a balanced manner. The *Indian Government* has taken many initiatives in this regard. The *Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ),* under the *Indo-German Development Cooperation* has been actively providing technical assistance to the *Indian Government* for over a decade now.

The publication on *Pathway to Eco Industrial Development in India* effectively highlights various areas of work with specific examples of the achievements in sustainable development.

I believe the publication will help in over-viewing the pathway taken so far on *Eco Industrial Development in India* and subsequently to strategise future course of action.

Dr. Tishya Chatterjee

India, a fast developing country, faces the challenge of balancing rapid development with sustainable inclusive growth. Technological progress, a growing knowledge base, active participation of the civil society, and international co-operation offer unprecedented opportunities for India to meet its sustainability goals.

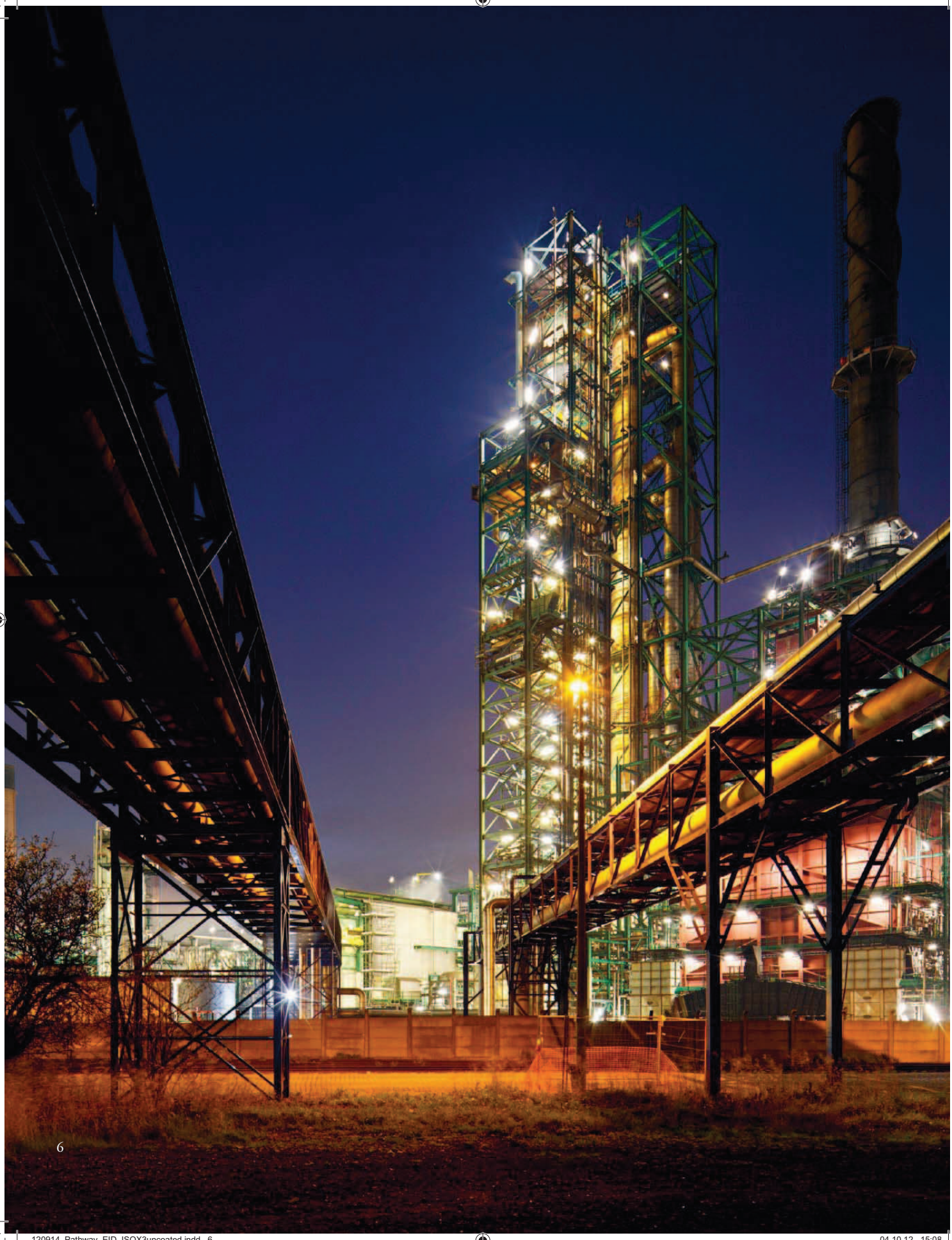
Germany has been cooperating with India for more than 50 years. Its international cooperation endeavours focus on positive impacts in shaping the future. The *Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ)* as the German implementing agency for international cooperation counts on longstanding partnerships in India that strive for forward-looking, efficient, effective and sustainable solutions.

GIZ is active in a wide variety of developmental fields. For many years, it has tapped the opportunity of turning the challenges posed by rapid industrialisation towards sustainable development, and has adopted *industrial development* as one of its key areas of work. It undertook a number of initiatives for introducing *Eco Industrial Development* in India under the *Advisory Services in Environmental Management (ASEM).*

GIZ and the *Indian Ministry of Environment and Forests* developed this publication to sum up the concept and take stock of what has been done and achieved so far. This important work on *Eco Industrial Development* will continue under the *Indo German Environment Partnership (IGEP) Programme* which started in March 2012 and will last until 2018.

I would like to take this opportunity to thank all of the involved national and international experts, company representatives and officials for their valuable inputs and comments.

Dr. Dieter Mutz, GIZ



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1. INTRODUCTION
ECO INDUSTRIAL DEVELOPMENT

1.1. Overview
1.2. Learning from International Experience

1.1. Overview

Over the last few decades, industrialisation is increasing substantively, especially in emerging economies like India. Industrialisation, if not properly planned, is associated with environmental risks caused by unrestrained consumption of natural resources, pollution, and disasters. The impacts of industrialisation get exacerbated with those of climate change. This situation calls for development of approaches that satisfy the growing needs of the Indian population without either damaging the natural environment irreversibly or contributing to climate change.

Internationally, there have been several concepts such as *Industrial Ecology, Eco Industrial Parks, Resource Efficiency,* and *Industrial Symbiosis,* which have been developed to combat the risks of industrialisation and support sustainable development. In India too, as in most other parts of the world, several of these concepts have been applied in recent years. Successes from these concepts vary from one industrial sector or geographic region to another. These concepts, in one way or the other, support balancing environmental, social and economic interests. *Eco Industrial Development* is an overreaching framework and a subset of sustainable development, while *Industrial Ecology, Industrial Symbiosis* etc. are specific strategies.

Industrialisation is an important driver for development. Focusing on proper planning and development of industrial areas, such as industrial estates, industrial parks, special economic zones, or investment zones could contribute significantly towards the goal of sustainable development.

Not only the industrial areas, but also the individual companies within these areas need to strive for achieving greater competitiveness by resource-efficient modes of production. Efficiency strategies play an increasingly important role for emerging economies such as India for becoming competitive locally as well as globally, especially in compliance of the recent conventions and treaties.

Concepts and Approaches for Sustainable Industrial Development

Industrial Ecology is the study of the flows of materials and energy in industrial and consumer activities, of the effects of these flows on the environment, and of the influences of economic, political, regulatory, and social factors on the flow, use, and transformation of resources.

Industrial Symbiosis is a cooperation between different industries by which the presence of each increases the viability/ profitability of the other(s), and by which the demands of society for resource savings and environmental protection are considered.

Environmental Management Systems are environmental management approaches that identify the environmental aspects of a company's operations and legal requirements, establish environmental objectives and targets, create a set of management programmes to meet these objectives and targets, establish internal and external reporting systems including regular audits, reports to management, and provide follow-up on the audit findings and reviews to ensure continual improvement.

Design for the Environment evolved out of product life-cycle analysis and concurrent engineering. This work considers all potential environmental implications of a product: energy and materials used in the product, its manufacture and packaging, transportation, consumer use, reuse or recycling, and disposal.

1.2 Learning from International Experience

Initial Concepts

At the *United Nations Conference on Environment and Development (UNCED)* in Rio de Janeiro in 1992, nearly 180 nations resolved that in order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it *(Rio Declaration on Environment and Development)*. Nations have agreed that sustainable development should be the goal and operating principle for governments, businesses and individuals around the world. The *Agenda 21* calls for the development of national strategies for sustainable development. The *Eco Industrial Development (EID)* concept was first described during a presentation at this very conference.

Since 1993, the EID concept became well-known in the USA through its introduction by *Indigo Development to the US-Environment Protection Agency (Lowe et al.1998)*. In the United States, in 1993, a *President's Council on Sustainable Development* with representatives from business, labour, government, environmental organizations and civil rights organizations was constituted. The *Council* recommended assistance to create *Eco-Industrial Parks (EIP)* as models of industrial efficiency.

As defined in the *Eco Industrial Park Handbook*[1] *(Lowe 2001)* for Asian Developing Countries, *An Eco Industrial Park or Estate is a community of manufacturing and service businesses located together on a common property. Member businesses seek enhanced environmental, economic, and social performance through collaboration in managing environmental and resource issues. By working together, the community of businesses seeks a collective benefit that is greater than the sum of individual benefits each company would realize by only optimizing its individual performance. The goal of an EIP is to improve the economic performance of the participating companies while minimizing their environmental impacts. Components of this approach include green design of park infrastructure and plants (new or retrofitted); cleaner production, pollution prevention; energy efficiency, and inter-company partnering. An EIP also seeks benefits for neighbouring communities to assure that the net impact of its development is positive.*

Cooperation can have different forms and intensity. *Figure 1.2 (Cohen-Rosenthal 1999)* gives more detailed examples of cooperation option for companies oriented towards EID. The anticipation of these benefits can serve as an incentive for companies to improve their environmental and economic performance through more efficient management of raw materials, energy and waste. However, this requires a lot of foregoing activities such as consciousness building, facilitation of stakeholder dialogues, management support, and others – all of which are important elements of a strategy to foster resource efficiency.

The benefits to communities and businesses for adopting EID strategies are numerous, depending on the local conditions. *Table 1.2* lists some of the potential benefits to communities, the environment, and businesses.

1) Ref: *http://indigodev.com/Ecoparks.html*

Quality of Life/Community Connections
» Integrating Work and Recreation
» Cooperative Education Opportunities
» Volunteer and Community Programs
» Involvement in Regional Planning

Materials
» Common Buying
» Customer/Supplier Relations
» By-product Connections
» Creating New Material Markets

Transportation
» Shared Commuting
» Shared Shipping
» Common Vehicle Maintenance
» Alternative Packaging
» Intra-park Transportation
» Integrated Logistics

Environment, Health & Safety
» Accident Prevention
» Emergency Response
» Waste Minimization
» Multi-media Planning
» Design for Environment
» Shared Environmental Information Systems
» Joint Regulatory Permitting

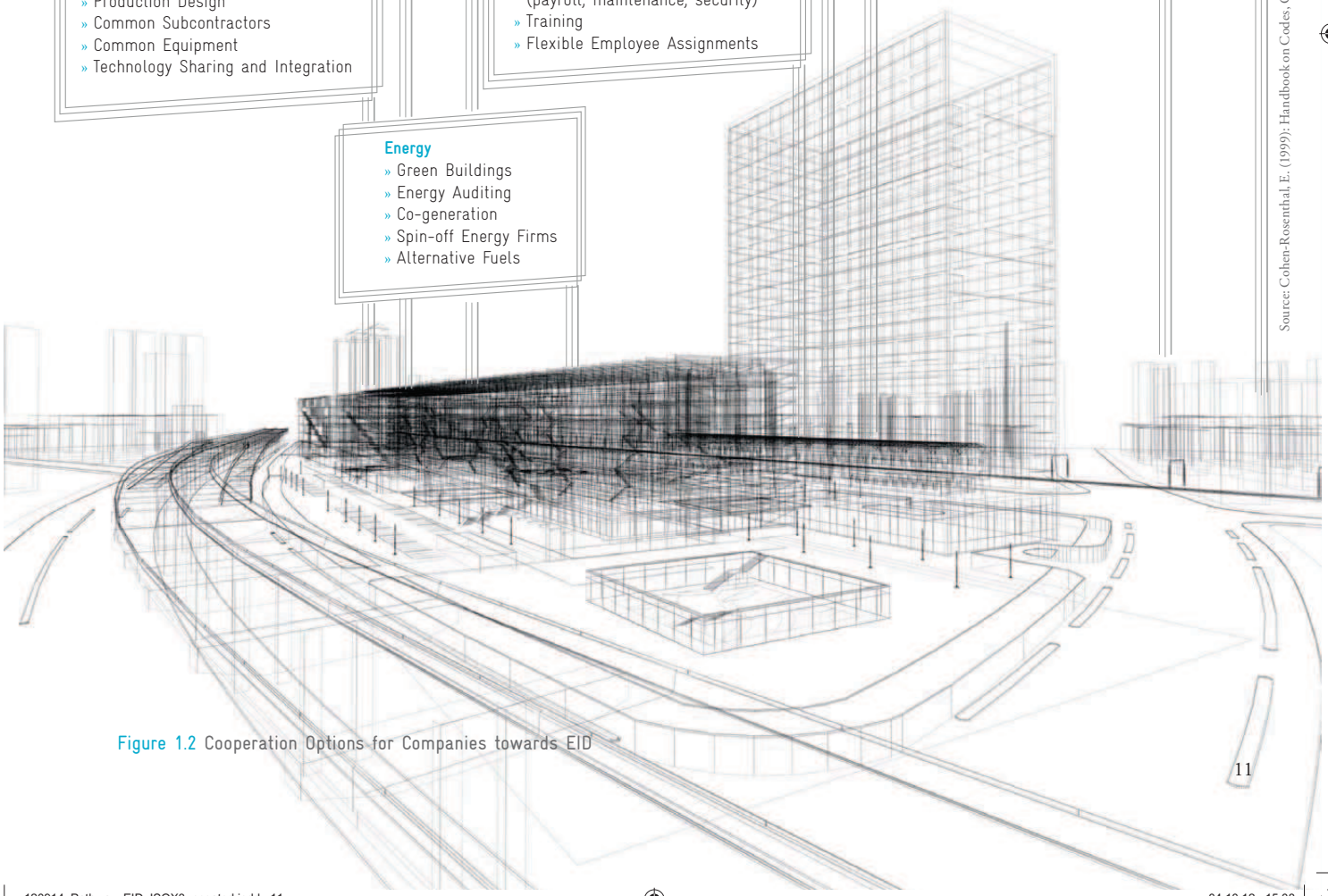
Information/Communication Systems
» Internal Communications
» External Information Exchange
» Monitoring Systems
» Computer Compatibility
» Joint Management Information System for Park Management

Marketing
» Green Labeling
» Accessing Green Markets
» Joint Promotions (e.g. advertising, trade shows)
» Joint Ventures
» Recruiting New Value-Added Companies

Production Processes
» Pollution Prevention
» Scrap Reduction and Reuse
» Production Design
» Common Subcontractors
» Common Equipment
» Technology Sharing and Integration

Human Resources
» Human Resources Recruiting
» Joint Benefits Packages
» Wellness Programs
» Common Needs (payroll, maintenance, security)
» Training
» Flexible Employee Assignments

Energy
» Green Buildings
» Energy Auditing
» Co-generation
» Spin-off Energy Firms
» Alternative Fuels



Source: Cohen-Rosenthal, E. (1999): Handbook on Codes, Covenants, Conditions, and Restrictions for Eco-Industrial Parks.

Figure 1.2 Cooperation Options for Companies towards EID

Table 1.2 Potential Benefits of Eco Industrial Development

Communities	Environment	Business
Expanded local business opportunities	Continuous environmental improvement	Higher profitability
Improved tax base	Reduced pollution	Enhanced market image
Community pride	Innovative environmental solutions	High performance workplaces
Reduced waste disposal costs	Increased protection of natural ecosystems	Improved efficiency
Improved environment and habitat	More efficient use of natural resources	Access to financing
Recruitment of higher quality companies	Protection and preservation of natural habitat	Regulatory flexibility
Improved health for employees and community		Higher value for developers
Partnership with business		Reduction of operating costs (i.e. energy, materials)
Minimized impact on infrastructure		Reduction in disposal costs
Enhanced quality of life near eco-industrial development		Income from sale of by-products
Improved aesthetics		Reduction of environmental liability
Good jobs		Improved public image
Increased employee productivity		

Source: Cohen-Rosenthal, E. (1999): Handbook on Codes, Covenants, Conditions, and Restrictions for Eco-Industrial Parks.

Over the years, the EID concept has evolved with expanded scope due to added concerns such as climate change. EID concepts have been applied in one form or the other in several countries in America, Europe, Asia, and Africa.

A Few Examples

All over the world, different aspects of EID have been implemented. One of the earliest examples of the form of *Industrial Symbiosis* can be found in Kalundborg, Denmark. The Kalundborg case started with a project in 1961 to use surface water from Lake Tisso for a new oil refinery in order to preserve the limited supplies of ground water. During subsequent years, cooperation between companies emerged and Kalundborg became the best known example of an industrial ecosystem where one company's by-product became an important resource to one or several of the other companies. The outcome was reduction in resources consumption as well as in negative impacts on the environment. The collaborating partners also benefitted financially from the co-operation because the individual agreements were based on commercial principles. For example, the waste heat from a power plant is used by the municipality and a fish farm, fly ash from the power plant is used by a cement plant, yeast slurry from a company is used in a pig farm. Other examples include waste water, steam, cooling water, etc. exchanged between industries.

The *Bayer Chemical Park at Leverkusen* in Germany was established way back in the year 1891. The industrial plants changed over time but the industrial park exists successfully even today because it was well planned with appropriate block/plot sizes, infrastructure and management structures. Similar chemical parks are located at Dormagen and Krefeld-Uerdingen that came up later. As a private park operator, *CURRENTA* takes care of these three industrial parks located at Leverkusen, Dormagen and Krefeld-Uerdingen with a total area of approximately 11 km². It facilitates material exchanges, sets up adequate environmental infrastructure, offers services, and supports the companies in their communication with the municipality.

The *Shanghai Chemical Industrial Park (SCIP)* in Shanghai, China with its 5,560 acres is based on *Eco Industrial Park* concepts. SCIP claims to have adequate environmental infrastructure and services as well as disaster management facilities, and has whopping investment targets of US$ 35-50 billion at the site.

EID in the Philippines focused on developing EID concepts, manuals and guidelines, setting up an *EID Information Management System,* undertaking pilot projects on cleaner production in industries, planning disaster management, setting up vermi-compost plants, and undertaking CSR activities related to health and sanitation.

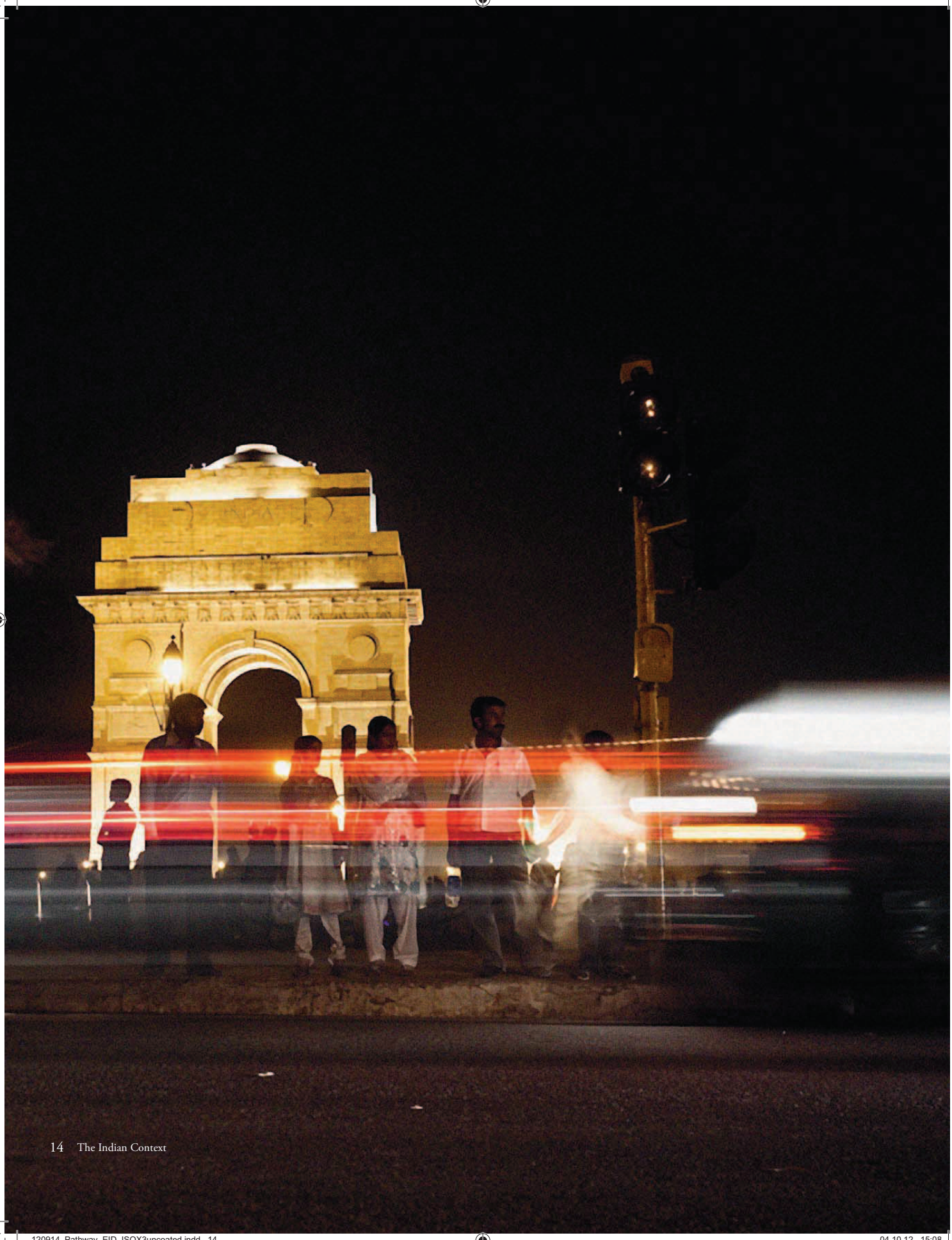
EID in Indonesia includes setting up of *Community Dialogue Forums (CDP)* to create understanding and to ease potential conflicts among stakeholders; setting up of *Cleaner Production Clubs (CPC)* among companies to work together to save money and reduce waste through networking, strengthening infrastructure, and preparing *EcoMaps* for industrial parks from GIS-based information *(Geographic Information System).*

EID in Tunisia includes establishing management associations *(groupements de maintenance et gestion – GMG),* surveying and assessing industrial areas, developing action plans, creating attractive green and public areas, preventing floods, improving management of water and waste water, managing risks in a better way and improving safety and security.

EID in Thailand focuses on risk assessment and risk profiling of selected industrial areas. It encompasses developing chemical safety management guidelines and a tool kit, promoting safe transport and storage of dangerous goods, and creating effective emergency management plans.

The EID approach employs a wide variety of measures and tools. Whether working on the policy level, the industrial park level or the single company level, a customised mix of measures and tools is required. Working on *Eco Industrial Development* in several countries across the globe, GIZ, together with its international partners, has developed a variety of such tools that have been compiled into the *EID Toolbox.*[2]

2) Ref: *http://www2.gtz.de/network/eid-toolbox/index-asp* or contact *eid@giz.de.*



2. THE INDIAN CONTEXT

2.1 Industrial Development in India
2.2 Cooperation towards EID
2.3 Relevance of EID Concepts for India

2.1 Industrial Development in India

India's economy is booming. The *Gross Domestic Product (GDP)* arising from the industrial sector (mining and quarrying, manufacturing, electricity, gas and water supply, and construction) showed an annual average growth of 8.1 % in 2010/2011.[3] Besides textiles, traditionally a very important industry in India, heavy industry, mechanical engineering and chemicals predominate. The space, electronics and nuclear industries are also relatively highly developed.

India has over three million *Small and Medium Enterprises (SMEs)*. Since the beginning of planned economic development, India has followed a policy for the development of industrial estates and industrial parks to facilitate the establishment of small and medium industrial units. *Special Economic Zones (SEZ)* have been developed to host bigger companies. Recent trends show setting up of *Special Investment Zones/ Regions, National Manufacturing and Investment Zones (NMIZ),* and *Petroleum Chemicals and Petrochemical Investment Zones (PCPIR),* in addition to the SEZs and the more traditional industrial estates and industrial parks.

Many existing industrial estates face severe environmental problems due to the lack of environmental infrastructure. With regard to *Common Effluent Treatment Plants (CETP)*, as per a study of the *Central Pollution Control Board (CPCB)* in 2005, only 6.4 % of about 78 CETPs studied comply with the standards. With regard to wastes, there still are problems associated with *Hazardous Wastes,* e-wastes, and non-hazardous industrial wastes. Towards the end of the *Tenth Five Year Plan* (2002-03 to 2006-07), there were many schemes for the improvement of these estates as well of as industrial clusters outside the estates. However, a *Comprehensive Environmental Pollution Index (CEPI)* which was developed by CPCB for industrial estates showed that as per the initial study taken up for 88 industrial areas in 2009–10, 43 of these areas were critically polluted with respect to one or more environmental components.

Industrial effluents comprise organic pollutants, chemicals, heavy metals, and run-offs from land-based activities such as mining. These are major sources of water pollution. Major water polluting industries include fertilizers, refineries, pulp and paper, leather, metal plating, and other chemical industries. The existing pollution abatement infrastructure includes installations by individual industries as well as common infrastructure in the form of CETP. Fly-ash, phospho-gypsum, and iron and steel slags are main forms of industrial solid wastes generated in India. It is estimated that around 112.29 million tonnes of fly-ash is generated annually by thermal power plants, of which only 53.92 million tonnes are utilized by different sectors like cement, road embankments, fly ash bricks and products, and back filling of mines. Besides, there are 36,145 *Hazardous Waste* generating industries in the country producing 6.2 million tonnes of *Hazardous Waste* every year, brought about by expansion of chemical-based industries. It is further estimated that about 147,000 million tonnes of e-waste was generated in the country in 2005, which is expected to increase to about 800,000 million tonnes by 2012.

3) Review of the Economy 2010/11, Economic Advisory Council to the Prime Minister, February 2011, New Delhi

High growth rates of industry and pollution problems potentially increase pressure on climate and the environment. Fortunately, environmental and climate change issues are high on India's political agenda and initiatives have been taken by the towards climate friendly and sustainable development. The *National Environmental Policy* (2006), the *National Action Plan on Climate Change* (2007), the *Low Carbon Inclusive Growth Strategy* (2011), and the *National Manufacturing and Investment Zone Policy* (2011) are a few to name.

The *Government* has notified emission and effluent standards under the *Environment (Protection) Act* 1986. The concerned *State Pollution Control Boards/ Pollution Control Committees* along with the *Central Pollution Control Board (CPCB)* monitor the effluent discharges, emissions and wastes. As in the year 2009, a total number of 2,504 industrial units have been identified as polluting, out of which 1,810 have set up pollution control facilities to comply with standards, 265 are defaulting, and 429 have been closed. The *Charter on Corporate Responsibility for Environmental Protection (CREP)* covers 17 categories of highly polluting industries that provide for voluntary pollution control commitments by various industry sectors.

Other measures taken by the *Government* towards effective control of industrial pollution include inspection and enforcement of emission and effluent standards through issue of directions and consent mechanisms, mandatory prior environmental clearance for designated development projects, financial assistance for the establishment of CETPs for small-scale industrial units located in industrial clusters, identification of critically polluted areas, and preparation of action plans for the abatement of pollution.

(Source: http://indiabudget.nic.in/ Economic Survey 2010-11, Ministry of Finance).

2.2 Cooperation towards EID

A comprehensive, yet customised EID approach has substantial benefits for the industry, environment and communities. Under the *Advisory Services in Environmental Management (ASEM) Programme* of the *Indo German Development Cooperation,* a number of initiatives were taken since 2002 to assist the *Indian Government* on its pathway to *Eco Industrial Development.*

2.3 Relevance of EID Concepts for India

While there are different EID concepts and approaches, it is important to understand what it actually means to foster EID, particularly for emerging economies such as India. An EID strategy, appropriate for India, deals with the individual industry level, the industrial park level, as well as regional, national and global levels. All three levels are relevant: micro, meso and macro. While single companies need to take action, the industrial park level is an ideal structure to initiate and implement savings through resource exchanges and shared facilities. The regional level helps strike a balance between socio, economic and environmental aspects. On the national level, enabling framework conditions have to be worked out. Furthermore, in the context of the two *UN conferences on Climate Change* in Durban, South Africa, in 2011 and on *Sustainable Development* in Rio, Brazil, in 2012, a global perspective is relevant to the topic.

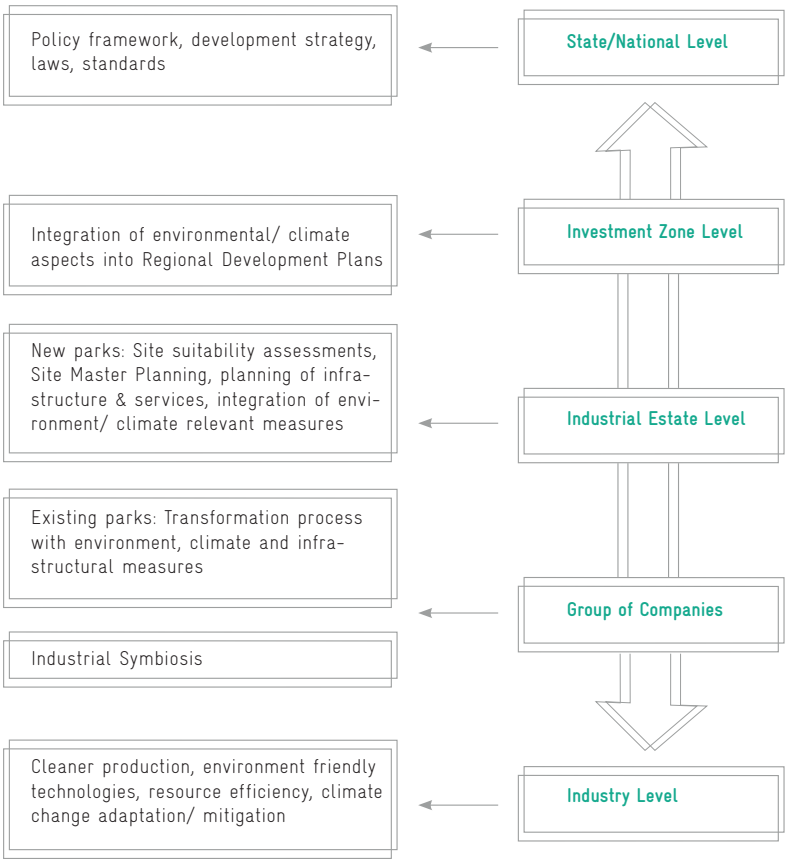


Figure 2.3 Eco Industrial Development Approach

3. EID APPROACH: AT INDUSTRIAL PARK LEVEL

3.1 New Industrial Parks
3.2 Existing Industrial Parks
3.3 Infrastructure Development
3.4. Management Improvements
3.5. Climate Change Considerations

3.1 New Industrial Parks

3.1.1 New Industrial Parks

An industrial park is a site accommodating several industrial companies. In the past, industrial parks in India have often been developed as agglomerations of companies housed on smaller plots of land with low investments and limited services and synergies. Looking at the recent trends across the globe, as in the case of *Special Economic Zones (SEZ),* several governments have decided to set them up with an effective planning process beforehand including incentives for a more environmental and climate friendly production. South Korea, China and the United Arab Emirates have, for example, taken great strides in implementing low-carbon green SEZs. In the United Arab Emirates, *Jebel Ali Free Economic Zone (Jafza)* has managed to save $1.03 million through sustainable measures such as proper planning, energy efficiency, renewable energy supply, water savings, waste recycling and green building codes. In addition, SEZs, by becoming local centres for development and deployment of green technologies, have proved effective in facilitating knowledge transfer and sharing innovations.

In India as well, the advantages of a proper planning processes for the development of new industrial parks have become obvious. India's *Special Economic Zones (SEZs) Policy* announced in the year 2000 intends to establish SEZs, backed by quality infrastructure and attractive fiscal package, as an engine for economic growth, both at National and State level. Also, the recently announced *National Manufacturing Investment Zones (NMIZ)* (2012) are proposed to have good physical infrastructure and structures to support resource efficient technologies.

Concept

Important elements of planning a new industrial park include:

- vision for site development with environment and climate orientation
- siting/ site selection
- defining investment and employment targets
- market analysis on potential investments
- identification of investors
- *Environmental Impact Assessment (EIA)*
- *Site Master Planning*.

At all the stages of planning, reliable data is crucial. However, the availability of reliable data is often challenging when planning is introduced for the first time and only becomes less difficult with the passage of time and adequate processes of data collection in place.

Planning an industrial park is more than just a technical exercise. It encompasses stakeholder participation and consultations at various stages. *Stakeholders* refers to neighbouring communities, companies, local authorities, and political decision-makers.

Case

3.1.2 Site Suitability Assessment

Suitability assessments within the park identify areas with constraints such as those prone to erosion or floods, and areas with environmental functions such as ground water recharge zones. Planners determine block sizes for industries, considering the type of industries likely to be established at the site. Decisions are based on market surveys combined with site suitability assessments.

The *Krishnapatnam International Leather Complex Private Limited (KPILC)* is a *Special Purpose Vehicle (SPV)* company initiated by the *Government of Andhra Pradesh* for the development of an integrated Leather Park on the east coast of India. The state government conceptualised this project along with the technical co-operation of the *Central Leather Research Institute (CLRI)* of India.

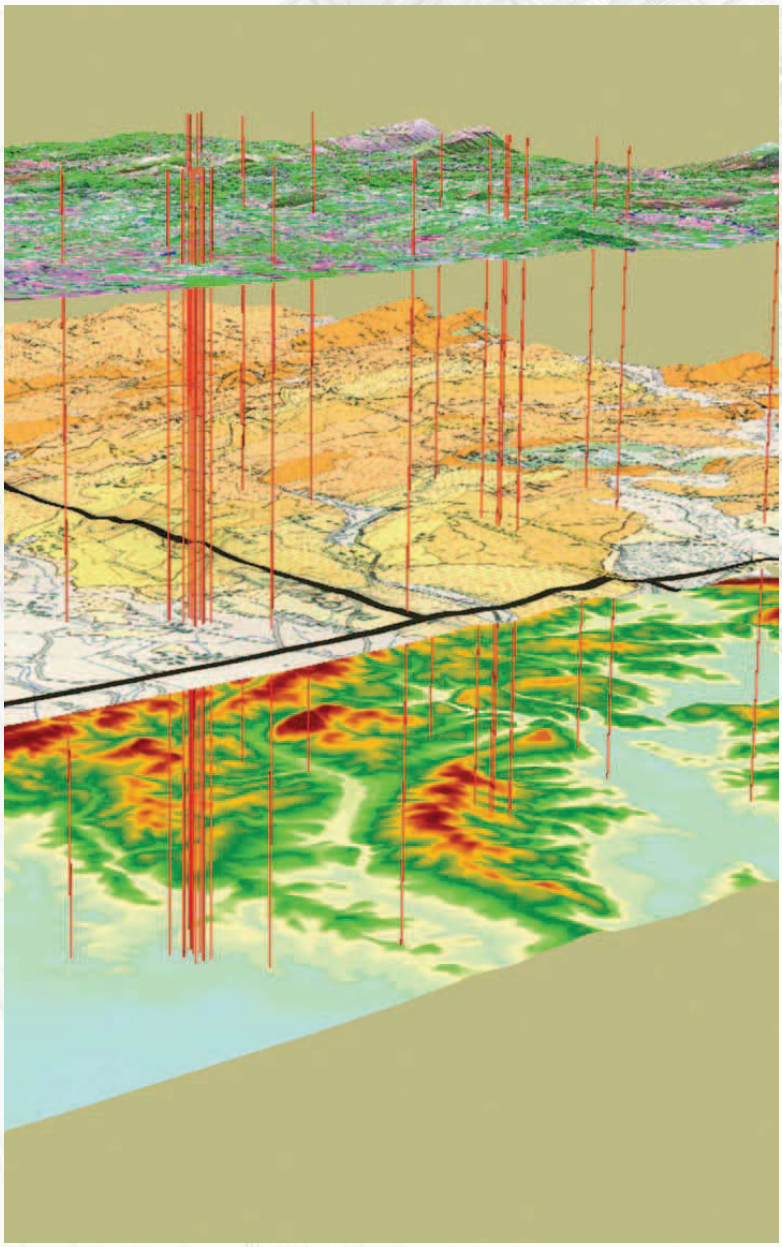
KPILC envisages to develop an environmental-friendly complex for the leather sector (especially tanning units), which is traditionally regarded as a highly polluting industry. The planned integrated environmental management systems for the complex would make it a benchmark for other proposed leather parks in the country and also be at par with other international leather parks globally. For setting up the project, KPILC initially identified two alternate sites in Nellore District, Andhra Pradesh. *L&T-RAMBØLL Consulting Engineers Limited* was appointed as the consultant for assessing the site suitability for the project and also for preparing the *Conceptual Site Master Plan.* Various parameters were studied for assessing the site suitability including location, extent of land and its availability, connectivity, physical features (terrain, land use, and developable area), infrastructure availability, present level of pollution, social aspects, natural hazards, existing/ proposed developments in the region, environmental aspects including presence of environmental sensitive zones and resource areas in the proximity, e.g. coastal regulatory zones, reserved forests, wild life sanctuaries, endangered species, ground water recharge zones, etc.

Based on such an analysis, the first site located to the north of Krishnapatnam Port was found to be unsuitable for development of the Leather Park due to - (i) insufficient land availability, (ii) environmental impacts (owing to the passage of coal conveyors from the port to the nearby power plants and siting of the ash pond of a power plant adjacent to the site, and pollution caused by coal dust or dust from the ash pond that would have a negative impact on the leather industry processes,) and (iii) being partially located within the area of the coastal regulation zone. This site was then proposed to be developed for logistical activities only. It is reasonable due to its proximity to the port.

The second site located to the south of Krishnapatnam Port was recommended for the development of the Leather Park considering its relative advantages of land availability, amenable terrain for industrial development and minimal environmental impacts.

J.K. Smitha L&T – RAMBØLL Ltd.,
Senior Planner, Hyderabad, Andhra Pradesh

"In India, the availability of land for industrial use is decreasing by the day with increased public awareness on both environmental and social aspects associated with industrial projects. The past few years have seen a trend in developers seeking only suitable sites for project planning. This due diligence is helpful in providing caution on any issues relevant to the site prior to land acquisition."



Case

3.1.3 Environmental Impact Assessment

The *Environmental Impact Assessment* analyses the expected ecological threats, and in some cases, even disallows activities with adverse impacts on the environment. As per the *Environmental Impact Assessment Notification* of September 14, 2006 (as amended) of the *Environment (Protection)* Act, 1986, certain scheduled industries and industrial estates require prior *Environmental Clearance* for which an elaborate environmental impact assessment has to be undertaken by the proponents.

The SEZ Act 2005 envisages a key role for the *State Governments* in export promotion and creation of related infrastructure. Within this framework, the *Government of Andhra Pradesh* has initiated the development of several SEZs in the state. The *Andhra Pradesh Special Economic Zone (APSEZ)* is one of such SEZs which are strategically located in an industrial belt. It is close to Visakhapatnam, a port city. As per the EIA Notification, 2006, (as amended) issued under the *Environment (Protection)* Act, 1986, APSEZ having an area more than 500 ha and planning to house multi-product industries including chemical industries, requires to undertake *Environmental Impact Assessments* and obtain Environmental Clearance from the *Indian Ministry of Environment & Forests*.

The EIA process undertaken for APSEZ comprised four stages, viz. screening, scoping, public consultations and appraisal. Studies undertaken include:

- identification of ecologically/ environmentally sensitive zones within 10 km of the project radius and assessment of baseline environmental conditions
- identification and prediction of significant environmental impacts due to proposed APSEZ on various terrestrial and marine environmental components, including social impact assessment
- evaluation of significant impacts and delineation of impact mitigation measures
- preliminary risk analysis and disaster management planning
- analysis of alternate sites and identification of best suitable site
- preparation of environmental management plan and environmental monitoring plan for the construction and operation phases of the project for the best suitable site.

For APSEZ, the study phase was followed by a public consultation process where the project was presented to the local community in local language in the presence of the *State Pollution Control Board* and district authorities. The study then underwent appraisal process at the *Indian Ministry of Environment & Forests.*

Based on the EIA study, certain categories of industries not suitable to the site were restricted from setting up. Also, infrastructure such as separate pipelines for high TDS *(Total Dissolved Solids)* and low TDS effluents, an adequate area for reuse of treated waste water for irrigation purposes, guard ponds for storing treated waste water before disposal, online monitoring systems to check the quality of treated waste water, a desalination plant for meeting additional water requirements, a captive power plant for power generation and supply, etc. were provided for in the site master plan of APSEZ.

Key Features of APSEZ

- Environment, climate and energy related issues at planning stage were adequately considered and required land was allocated in the Site Master Plan.
- Very high emission industries that are not compatible to the site were restricted from the industrial park.
- For climate change adaptation, the aspects of stormwater drainage to cope with excess rain, recycling/ reuse of treated water for meeting with water shortages, adequate plantation to deal with micro climate control and temperature regulation were integrated.
- For effective waste water management, separate piping was provided for high and low total dissolved solid effluents. Common effluent treatment plants and sewage treatment plants were kept separate. Online monitoring systems were provided for key pollutant parameters at industry outlets as well as at the treatment plants. Furthermore, a facility to recycle treated waste water was provided.
- For reduced environmental impact, a systematic Environmental Impact Assessment (EIA) was undertaken, proper zoning of the site was done for different types of polluting industries, and adequate environmental infrastructure was planned.
- Solar street lamps were proposed in the park. A common co-generation plant is in the planning stage. Disaster risks were taken into consideration. A traffic and transportation plan was integrated into the Site Master Plan.
- The Site Master Plan included adequate parking areas, canteens, a business centre, and other services and logistics areas. Also, provisions were made for emergency exits in case of disasters.

Case

3.1.4 Site Master Planning

Site Master Planning is an important step for the development of any new industrial area. It helps to make industrial parks attractive and competitive. One of the first steps for undertaking *Site Master Planning* is to assess demands and the type of industries/ investments/ employment likely to come up at the site, an assessment of potentials/ resources/ sensitivities and the formulation of a vision and strategy for the industrial park. Secondly, environmental infrastructure requirements and environmental services needed at the site are also assessed.

Without proper planning, no common infrastructure and services are likely to be designed. Doing so at later stages could become costlier or even unviable. If industries are not grouped well, it becomes difficult, for example, to establish an effective sewerage system, waste management, effluent treatment, and other common infrastructure. Also, unstructured set-up of companies reduces options for resource exchanges and industrial symbiosis. Lack of buffer zones could pose challenges for compatibility with the neighbouring community.

The *Andhra Pradesh Industrial Infrastructure Corporation Limited (APIIC)* decided to set up the *Andhra Pradesh Special Economic Zone (APSEZ)* at Visakhapatnam with the underlying principles of *Eco Industrial Development*. The work on the *Site Master Planning* was undertaken by the national consultants *L&T – RAMBØLL Consulting Engineers Ltd.* under the technical guidance of *Bayer Technology Services (BTS)* from Germany. APIIC's objective was to establish an integrated well-planned infrastructure and an efficient management structure to ensure continual global competitiveness and to be seen as a benchmark in Andhra Pradesh and in the country – both in terms of market relevance and environmental sustainability.

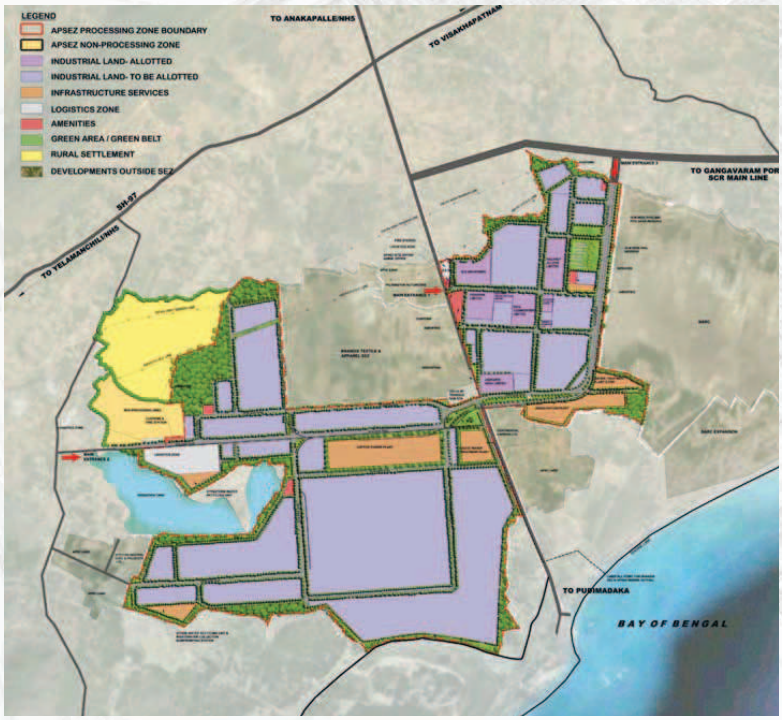
Aspects included were assessment of energy and water demand, generation of solid waste and waste water, land use and land cover, traffic situation and the need for environmental infrastructure like a *Common Effluent Treatment Plant* and common services like a hospital, a community hall, postal services, banks, canteens, etc.

As a result of the *Site Master Planning*, the site was divided into five industrial zones to house different industry sectors, viz. engineering, fine and specialty chemicals, as well as ancillary petrochemicals. Effective zoning showed possibilities for co-operation between companies while also optimising infrastructure and services. An area of 62 % was earmarked for the development of industrial units and 38 % of remaining space provided for the development of infrastructure services, common utilities, housing, and allied social infrastructure services.

C.V. Sundara Rajan L&T – RAMBØLL Ltd., Hyderabad City Office Manager

"India has an elaborate environmental legislation, however translating this into planning and implementation is often a challenge. For my team to perform the Site Master Planning tasks was not always easy due to data constraints. However, owning to customized technical approaches adopted, I can say that the results are convincing. We are following up for proper implementation of the plan and ensuring a successful operational phase so as to form a model for all new industrial areas planned."

Figure 3.1.4 Map of Andhra Pradesh Special Economic Zone



3.2 Existing Industrial Parks

Concept

3.2.1 Transformation of Existing Industrial Parks

To achieve the transformation of existing industrial parks, it is important to identify viable and environment-friendly solutions, and strengthen organisations as well as human resources for effective implementation. The scope of transformation of existing industrial parks includes the following key elements:

- improvement in infrastructure and services
- improvement in eco-performance of individual industries
- improvement of industrial park management.

Improvement in infrastructure and services: One important element of improving existing industrial parks is to introduce common services so that companies can better concentrate on their core businesses. Common services capitalise on the fact that companies are located in vicinity of other companies with similar needs. The following common services are relevant in an industrial park:

- environmental services – waste water collection, treatment and disposal systems (including sewers and *Common Effluent Treatment Plants);* drainage systems and rain water harvesting facilities; green belts and landscaping; waste (Hazardous Waste, non-hazardous industrial waste, municipal solid waste) management facilities
- energy services – electricity, steam, water, refrigeration, compressed air, natural gas
- monitoring services – air quality, water quality, product certification, environmental monitoring, green house gas accounting, permits
- site safety and security – site protection, fire prevention, disaster risk management
- infrastructure and real estate – facility management
- technical services – workshops, trainings, advisory services
- social services – hospital, canteen, childcare.

Improvement in eco-performance of individual industries: Eco-performance is an approach that targets improved efficiencies, cleaner production, reduced consumption of resources and reduced environmental impacts, thereby making it profitable for enterprises to adopt. There are several tools available based on this approach.

For example, the *EcoProfit* training tool aims to reduce the cost of operations in the companies by optimising process operations and minimising raw materials, water, waste and energy. *EcoProfit* follows an approach with paradigm shift from end-of-pipe solutions such as treating waste and emissions to a preventive approach such as minimising waste and emissions in the process itself with no or low costs. This and similar training tools not only help individual companies, but also support the overall sustainable development targets communatively. The approaches include application of cleaner production tools, energy and environmental audits, and by-product exchanges or industrial symbiosis – which means that a set of companies seek to utilise each other's by-products (energy, water, and materials) rather than these by-products disposed off as waste.

Improvement of industrial park management: *Environmental Management Cells* and *Geographic Information Systems (GIS)* are set-up for providing industry-wise details as well as status of infrastructure in the industrial park, awareness programmes, mock drills for disaster risk management, public relations / corporate social responsibility activities, facility management, etc.

Case

3.2.2 Transformation Examples

In Andhra Pradesh, an initial set of actions on state level took place between 2004 and 2007. Stakeholders prepared strategy papers and gained consensus on the measures to be taken. They undertook a number of awareness and training programmes along with measures towards plantation, which they considered easy to begin with. Subsequently, they also initiated measures towards strengthening the basic infrastructure, viz. storm water drainage, sewerage systems, plantation and waste water treatment through a *Common Effluent Treatment Plant*, etc.

As early as in the year 2007 the *Andhra Pradesh Industrial Infrastructure Cooperation Ltd. (APIIC)* decided to transform all its existing industrial parks into *Eco Industrial Parks (EIP)* in a phased manner. It implemented the first set of measures in industrial parks at Nacharam and Mallapur in the Moula Ali Zone near Hyderabad.

From the year 2008, APIIC itself increased its environmental staff and expanded efforts to several other industrial parks in Andhra Pradesh. From two pilot industrial parks, the efforts spread across to over 30 industrial parks in Andhra Pradesh.

Highlights from the pilot measures taken up in the existing industrial parks are given below:

- Environmental information reports were developed for six industrial parks to bring to the knowledge of the authorities the key environmental and infrastructure issues in the industrial parks and the need for improvement.
- Solar street lamps were installed in three industrial parks by replacing the conventional electric lights.
- Storm water drains were constructed initially in two industrial parks. Some of the low lying areas in these industrial parks were previously getting flooded forcing the industries to close their production. These industries are now free from such hazards.
- Sewerage systems were constructed in two industrial parks for carrying industrial effluents. A *Common Effluent Treatment Plant (CETP)* is in an advanced stage of completion. The industries, especially the chemical industries in these parks, were under tremendous environmental regulatory risks. Once the CETP is completed, the industries will benefit considerably, their regulatory risk will reduce substantially.
- Several companies such as *M/s Salicylates, Chemicals Pvt. Ltd.* and *M/s The Times of India* benefited from the application of the *EcoProfit* tool. The savings achieved from implementing environmental measures were to tune of Rs 25 million in the first year itself.
- Due to plantation measures taken up across several industrial parks, the parks have become greener. Besides improving aesthetics, it also improves the micro-climate to an extent.
- Improved environmental management in the industrial parks implies reduced illegal discharges of effluents and wastes besides overall improvement of the parks.

P.S.S. Naidu, President
Mallapur Industrial Units
Welfare Association
Hyderabad, Andhra Pradesh

"The introduction of the Eco Industrial Park concept and the employment of Environmental Cells has been God's gift to us. Roads are cleaner now, the estate is greener, air quality improved considerably, we know how to save energy within our production processes, we advanced in man power management. All of these changes have taken place without much money being involved."

Case

3.2.3 Environmental Management Cells

One element to improve an existing industrial park is to have a sound environmental management structure within the industrial park. In Andhra Pradesh, the industrial park authorities (known as *Industrial Area Local Authority (IALA))* were involved in functions such as maintaining roads, street lights and waste management. However, they lacked environmental expertise. To fill this gap, *Environmental Management Cells (EMC)* were set up, initially for industrial parks at Nacharam and Mallapur, to support IALAs with environmental management functions and support the improvement of environmental management in the industrial parks. Subsequently, the EMCs were expanded to over 30 industrial parks.

The following tasks are taken up by EMCs:

- provide technical, advisory, and planning support to IALA in all matters relating to environmental management
- provide or organise support services to individual industries in industrial parks on environmental related matters
- create environmental data banks
- ensure that the needed environmental infrastructure is identified in the industrial parks and give advice for implementation, operation and maintenance
- conduct and assist in pollution control monitoring
- take necessary actions for setting up emergency/ disaster plans and preparedness guides
- coordinate implementation of training programmes for IALAs and industries
- improve communication about environmental management between IALAs and further stakeholders.

After gaining good experiences from EMCs in Nacharam and Mallapur Industrial Parks, APIIC expanded the establishment of EMCs to six more zones (Shamshabad, Patancheru, Visakhapatnam, Kakinada, Nellore and Tirupati) catering to over 30 industrial parks. It outsourced the task of setting up these EMCs to professional agencies. However, in due course, APIIC considered it useful to strengthen its own staff instead of outsourcing. Now, it has environmental staff at its Zonal Offices to look into the environmental management functions.

3.3 Infrastructure Development

Concept

3.3.1 Waste Management

Industrial waste is any type of solid waste that any industry generates/ produces through industrial/ commercial activity. This waste may be hazardous and/ or non-hazardous. Nevertheless, it requires to be managed properly. The Indian legal system has a separate focus on each type of industrial waste. However, in general, the industrial waste is dealt with in three major environment laws of the country – *Water (Prevention and Control of Pollution) Act, 1974; Air (Prevention and Control of Pollution) Act, 1981; and Environment (Protection) Act,* 1986.

A guiding concept for waste management is named *3R* which refers to reduce, reuse and recycle. It calls for an increase in the ratio of recyclable materials, reuse of raw materials and manufacturing wastes, and overall reduction in resources and energy used. Objectives should be applied to the entire life-cycles of products and services – from design and extraction of raw materials to transport, manufacture, use, dismantling/ reuse and disposal.

In order to manage *Hazardous Waste* in an environmentally sound manner, the *Ministry of Environment & Forests (MoEF)* of the *Government of India* notified the *Hazardous Waste (Management & Handling) Rules,* 1989, under the provisions of the *Environment (Protection) Act*, 1986.

Waste management includes collection, segregation, storage, transportation, treatment and disposal. For cost effective waste management, it is necessary to explore the possibilities of waste minimisation through process improvements and to recycle and reuse to the extent possible. Waste management is also carried out to recover resources from it. The reuse of wastes could be done either within an industry or through exchanges in a network of industries (industrial symbiosis).

As per an estimate, the *Hazardous Waste* generated in India per annum is estimated to be about 4.4 million tonnes (1999, *Report of the High Power Committee on Management of Hazardous Wastes*). As per the *Hazardous Waste Management Rules,* every industry generating *Hazardous Waste*s shall have to obtain an authorisation for collection, reception, treatment, transport storage and disposal of such wastes. Also, any person who intends to be an operator of a facility for the collection, reception, treatment, transport, storage and disposal of *Hazardous Wastes,* shall have to also seek authorisation for taking up any of these activities.

Lack of Hazardous Waste management facilities could lead to illegal and wild dumping of wastes posing serious threats to the environment. India has several facilities for treatment, storage and disposal of *Hazardous Wastes.* However, the number of these facilities is much lower than the target of having at least one such facility in every district of the country. The *Common Treatment, Storage and Disposal Facility (TSDF)* set up at Dobbasapete near Bengaluru in Karnataka in recent years is one such example.

E-waste is another issue related to waste management. MoEF passed the *E-waste (Management and Handling) Rules,* 2011. While until now waste goes through formal recycling facilities, a good amount of e-waste in India is handled by the informal sector. A successful example lies in Bengaluru, an IT hub, wherein a part of the informal sector was formalised to ensure proper e-waste management.

Case

3.3.2 Hazardous Waste Treatment Plant

To manage *Hazardous Waste (HW)* in the state of *Karnataka, the Karnataka State Pollution Control Board (KSCB)* initiated setting up of a *Common Treatment, Storage and Disposal Facility (TSDF)*. The *TSDF Dobbasapete* near Bengaluru in Karnataka was developed in a systematic way following international norms from inception to commissioning. It is meant to be a showcase for other states.

To start the process of establishing a TSDF, all the companies in Karnataka likely to generate *Hazardous Waste* were surveyed to determine the quantity of *Hazardous Waste* existing in Karnataka. The assessment of 1,600 industries concluded the requirement of TSDF capacity to handle 40,000 tonnes of *Hazardous Waste* per annum. This study also determined the types and characteristics of *Hazardous Waste* generated in Karnataka from various industries. The suitability of the site was assessed with respect to geological, hydro-geological and geo-morphological conditions and operational aspects, followed by a detailed *Environmental Impact Assessment (EIA)*. Further, a detailed technical concept, a financial proposal, and a note about its compliance status with legal requirements were prepared.

To tackle the NIMBY syndrome *(not in my back yard)*, an intensive public awareness campaign was conducted in the surroundings (within a radius of 5 km of the site) for a period of seven months where all the stakeholders were appraised about the project. Door-to-door campaigns and meetings with political leaders, religious leaders, school teachers and technical university experts were conducted. Also, NGOs and local communities were briefed about the project. A public hearing was conducted, and environmental clearance was obtained for the project from the government.

Consultations with industries, industrial associations, government agencies and NGOs were carried out to decide on the operator model for the TSDF. The operator model chosen for *TSDF Dobbasapete* was based on the principle of *DBOOT (Design, Build, Own, Operate and Transfer).* In the initial years, the facility will be monitored and managed by a Contracting Authority which is the *Karnataka Industrial Areas Development Board (KIADB)*. Later a *Special Purpose Vehicle (SPV)* company will take over. The SPV will have members of industrial associations and *Government* representatives.

The TSDF is established on an area of around 93 acres of land and comprises a landfill, a storm water management system, a rain water harvesting system, a sewage water treatment system, a safety control system, leachate treatment management ponds and monitoring wells to detect contamination of groundwater due to accidental seepage of leachate. Also, the facility has an analytical laboratory where samples of waste from each of the vehicles bringing in waste are tested. The TSDF has a green belt, which covers 30 % of the total area at present and will further increase to 90 % after twenty years of usage.

By now, the *TSDF Dobbasapete* in Karnataka has land-filled 58,000 million tonnes of *Hazardous Waste*, and has collected and stored 8,042 MT of it from 215 industries. Over the 51-years lifetime of the site, the total investment costs are estimated to be about 54 crores (= 540 million) rupees.

Hazardous Waste: Case
Meera Saksena, Additional Chief Secretary
IAS, Government of Karnataka
Bangalore, Karnataka

"The establishment of the state-of-the-art TSDF in the KIADB industrial estate is a step towards promoting integrated waste management facilities within industrial areas. The Government of Karnataka feels that the industrial areas should be self sufficient in terms of environmental infra-structure development."

Case

3.3.3 Formalisation of E-Waste Collectors

Bengaluru city, commonly known as the Silicon Valley of the country, is among the fastest growing cities of Asia. It is home to many industrial sectors of which the biggest is the information technology sector. This sector has a high proliferation of electrical and electronic products and e-waste. The city alone generates over 8,000 tonnes of e-waste annually, encompassing a range of obsolete electronic devices such as computers, servers, main frames, monitors, etc.

Although there are a few authorised (formal) e-waste recyclers in the country, almost 90 % of the e-waste in India is handled by the informal sector with crude reprocessing of material.

In Bengaluru, a pilot process for formalising e-waste recyclers was successfully implemented. A group of independent e-waste recyclers were transformed into a company named *E-WaRDD*. Extensive consultations were held to assess the past experience and cumulative capacity of the group members.

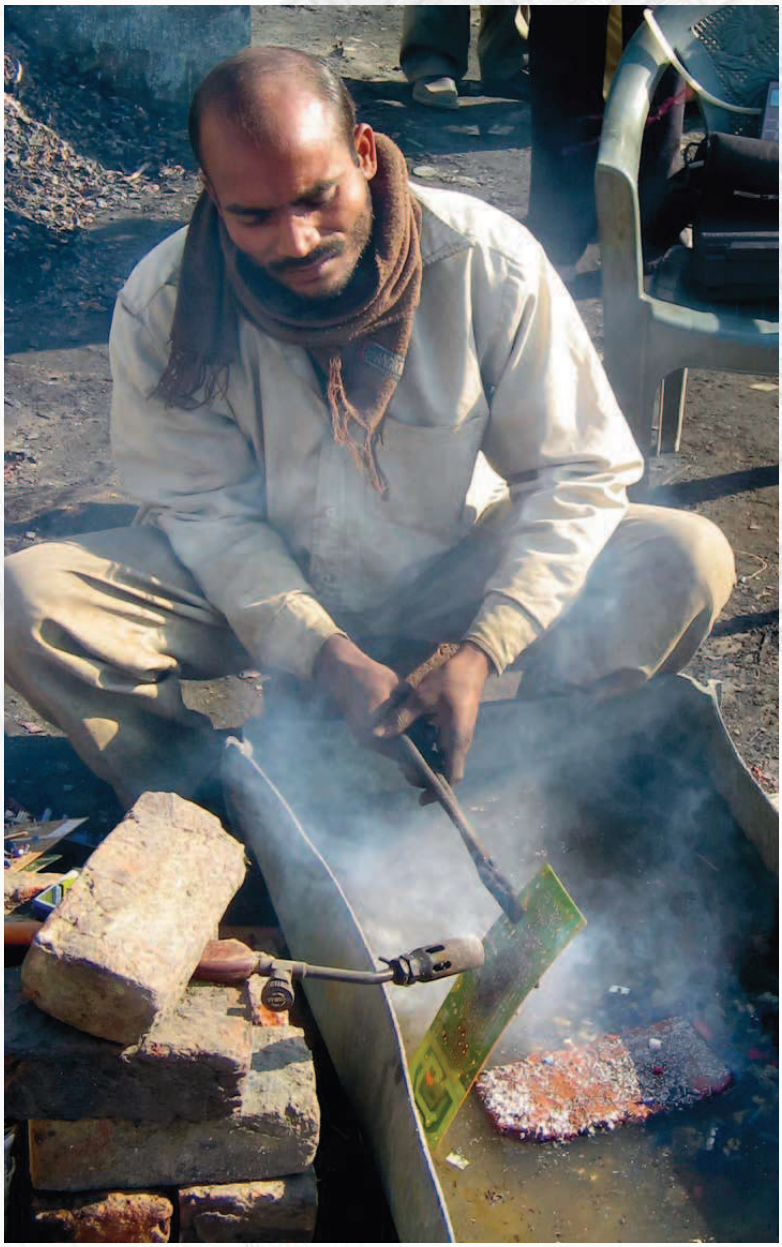
The newly formed company, *E-WaRDD*, has nine proprietors who have, on an average, 10 years of experience in recycling e-waste. The factory has a built-up area of 91 m^2 and includes a reception area, a storage area for raw materials, a processing area, an office and a service lab. The factory has an ergonomic plant layout, adequate lighting, as well as ventilation and dust extraction systems. The use of simple hand operated power tools has been employed in the dismantling operations in order to maximise productivity and minimise accidents. The process flow of the company has been optimised.

The effluents from the recycling process are in the form of solid waste, and liquid and air emissions. Although, the quantities are minimal, appropriate measures have been taken to contain and manage the pollution arising out of it. Conservation measures like roof top rainwater harvesting have been incorporated. Health and safety measures have also been taken into account for the plant.

E-WaRDD generates an average of 20 kg of solid waste per day comprising of thermocole, wood, glass and paper. This is stored in separate bins and disposed of as municipal solid waste. The domestic wastewater generated is about 120 litres per day. It is discharged into a decentralised wastewater treatment system / septic tank and a soak pit that has been provided to handle this wastewater. The total *Hazardous Waste* generated during the process of dismantling is a maximum of 300 kg per annum. The waste is collected, securely stored, and disposed off for proper management.

Ms. Uma Reddy,
EWA Board Member and President
Consortium of Electronic Industries
in Karnataka (CLIK), Bangalore

"E-WaRDD is the first ever informal recycler in the country to become a formal recycler! This has encouraged five other informal sector units to be formalised in Karnataka. To ensure sustainability of all these formalised units, the E-Waste Agency (EWA) in Bangalore is striving to encourage the e-waste generating companies to route their waste to these units"



Concept

3.3.4 Waste Water Management

Industrial processes are, in most cases, connected to water usage. The effluent discharges and any resulting pollution prove to be extremely harmful to the environment, especially if the effluents are of toxic nature and are not properly treated. In such cases, the neighbouring residential areas are also at risk. However, there are numerous processes that can be used to treat waste water as per its quantity and quality. Traditionally, waste water was treated at the treatment plants within the industries, which may include physical, chemical and biological treatment processes. However in India, in recent years, the concept of *Common Effluent Treatment Plants (CETP)* is becoming a popular as well as effective way to handle waste waters collectively by a group of industries.

CETP is the concept of treating effluents by collecting them together from different industries, mainly from within an industrial estate. Reasons to set up a CETP are manifold:

- *Economies of scale* in waste treatment can be achieved. The costs of pollution abatement for individual companies can thus be reduced.
- The problem of lack of technical assistance and trained personnel can be overcome as fewer plants require fewer employees.
- The problem of lack of space can be overcome as the centralised facility can be planned in advance to ensure that adequate space is available.
- *Pollution Control Boards* gain easier access to a CETP as compared to the access to small scale treatment facilities of single companies.
- The organisation of the disposal of treated wastes and sludge as well as the identification of reuse- and recycling options can be managed more efficiently.

Particularly for SMEs, it is becoming difficult for each industrial unit to provide for and operate an individual wastewater treatment plant because of the scale of operations, lack of space and technical manpower. Keeping in view the key role played by small scale industrial units and the constraints in complying with pollution control norms by these units individually, the *Ministry of Environment and Forests (MoEF)* of the *Government of India* initiated an innovative technical and financial support scheme to ensure their growth in an environmentally compatible manner. The scheme provides financial assistance for setting up of *Common Effluent Treatment Plants* with *Central Government* subsidy of 25 % and *State Government* subsidy of 25 % on the project capital cost. India today has over 145 CETPs.

CETPs have different technological options including primary, secondary and tertiary treatments and could even handle the recycling of treated waste water. Online monitoring systems for key parameters such as flow, pH, COD, etc., facilitate proper control and compliance with the discharge standards. Various business models exist for setting up and operation of CETPs, such as *BOO (Build, Own, Operate)* and *BOOT (Build, Own, Operate, Transfer)* by private operators and *PPP (Public Private Partnerships)* where public bodies play an important role in overseeing the management of the CETP and even putting in investments or providing grant support for making the facility viable and cost effective.

Case

3.3.5 Common Effluent Treatment Plant

As one of the components of transformation of existing industrial parks into *Eco Industrial Parks, the Andhra Pradesh Industrial Infrastructure Corporation Ltd. (APIIC)* is establishing *Common Effluent Treatment Plants (CETPs)* in its industrial parks spread across the state of Andhra Pradesh.

The industrial parks at Mallapur and Nacharam were selected as pilot study areas for transforming into *Eco Industrial Parks.* During the discussions with various stakeholders from the government, industries and consultants, the problem of treatment of industrial effluents and the pollution of the adjoining water bodies came to fore. It was decided to set up a CETP for treating the waste water in a collaborative process and cost-effective way.

Initially, APIIC appointed a private operator on *BOO (Build, Own, Operate)* basis for the industrial parks at Nacharam and Mallapur that are adjacent to each other. Considering the SME nature of industries in the two industrial parks and to make the setting up of CETP viable, APIIC made three acres of land available for the construction of the CETP. Also, the central and state governments provided grant support under the CETP scheme. However, mainly due to difficulties on financing by the operator, especially to provide additional facilities to meet the requirements of the *Pollution Control Board,* the construction of CETP got delayed.

In the meantime, particularly considering the long term sustenance of the CETP and its assured services, industrial park management along with APIIC and the tenant companies in the park decided on setting up a company in the form of a *Special Purpose Vehicle (SPV)* for day-to-day management of the CETP. The SPV was also expected to raise additional funds required for the construction of the CETP. They also decided that the private operator will build the CETP and operate it initially for a few years before handing it over to the SPV for operation and maintenance. The intervention of the regulatory authorities, the setting up of an SPV and the mobilisation of additional funds pushed the CETP operator to expedite its activities and it is expected that the CETP will soon be completed and commissioned.

For collection of effluents from different industries in the industrial parks, a sewerage network of 21 km in total length has been laid by APIIC. Upon completion, the CETP will cater to more than 650 industrial units of Mallapur and Nacharam. The CETP will receive mixed effluents from different sectors such as engineering, pharmaceuticals, chemicals, dyes and many others.